1. Background and Context

Tikapur Municipality, located in the Kailali District of Sudurpashchim Province, Nepal, is a region frequently affected by floods. Situated between the Karnali and Mohana rivers, the municipality's flat terrain makes it particularly susceptible to flooding during the monsoon season[1]. Tikapur Municipality covers an area of 122.12 square kilometres and comprises nine wards. According to the 2021 census, the municipality has a population of approximately 89,835 residents, with a slightly higher female population (52.9%) than males (47.1%). Most of the population relies on agriculture as their primary source of livelihood. Janaki Rural Municipality borders the municipality to the north, India to the south, the Karnali River to the east, and Bhajani Municipality to the west.[2] [3]

1.1 Flood Vulnerability and Early Warning Systems (EWS)

Municipality proximity to major rivers and low-lying topography contribute to its high vulnerability to flooding. The Karnali River, in particular, poses a significant threat due to its tendency to overflow during periods of intense rainfall. The municipality has experienced recurrent flooding events, with

[1] THT Online. (2023, December 20). *Transformative disaster risk reduction communication unveiled in Tikapur Municipality through scientific flood hazard mural art*. The Himalayan Times. https://thehimalayantimes.com/environment/transformative-disaster-risk-reduction-communication-unveiled-in-tikapur-municipality-through-scientific-flood-hazard-mural-art

[2] Khadka, H. R., & Shrestha, H. D. (2023, December). Reducing the vulnerability in Tikapur Municipality: A role of index-based flood insurance. *Proceedings of the 14th IOE Graduate Conference*, 227–231. Institute of Engineering, Tribhuvan University. https://conference.ioe.edu.np/publications/ioegc14/IOEGC-14-034-B4-6-789.pdf

[3] Nepal Live Today. (2024, July 8). *Floods, waterlog settlements in Kailali*. https://www.nepallivetoday.com/2024/07/08/floods-waterlog-settlements-in-kailali/

notable incidents occurring in 2006, 2008, 2013, 2014, and 2017. These events have led to widespread displacement, infrastructure damage, and agricultural productivity loss[4],[5].

In July 2024, continuous rainfall led to severe flooding in Tikapur and the surrounding areas. The settlements of Tikapur, Bhajani, Janaki, and Joshipur were inundated due to the rise in water levels of the Karnali and Patharaiya rivers. In the Tikapur Municipality, 65 houses in Parseni, Bhartapur, and Bhagwanpur of Ward 6 were inundated. Wards 2, 5, 7, and 8 were identified as high-risk zones for inundation[6],[7].

In October 2022, unseasonal heavy rainfall resulted in significant flooding in Tikapur. Nearly 700 families were displaced, and 47 houses were completely damaged. The floodwaters breached embankments, leading to the inundation of all wards, with wards 5, 6, 7, and 8 being the most affected. The disaster also caused substantial damage to paddy crops ready for harvest, raising concerns about food shortages[8].

The implementation of Early Warning Systems has been instrumental in enhancing community preparedness and response to flood events. Residents receive timely alerts through mobile messages, local radio broadcasts, and community networks, enabling them to evacuate and protect their belongings effectively. The increased awareness and utilization of EWS have contributed to minimizing casualties and property damage during recent floods[9].

In this regard, the Climate Adaptation and Resilience (CARE) for South Asia Project, supported by the World Bank and implemented by the Regional Integrated Multi-Hazard Early Warning System (RIMES), introduces the Satark Decision Support System (DSS). Satark is a digital platform that aggregates weather forecasts, climate data, and hazard-specific models to generate real-time risk information. It is tailored to support local governance bodies, emergency responders, and planners in making timely, informed decisions. The system supports four major hazard categories—flash floods, forest fires, landslides, and lightning and is equipped with localized flood forecasting capacities for Tikapur.

2. Purpose of the Community-Based Experience Sharing Event

Tikapur is a pilot district for flash flood hazards, which is covered by the Satark Decision Support System (DSS). This experience-sharing event offers an opportunity to introduce the system to local

[4] Rising Nepal Daily. (2022, August 5). *People residing in low-lying areas in Tikapur live in constant risk of floods*. https://risingnepaldaily.com/news/14986

[5] ReliefWeb. (2024, June 12). *Nepal: Western Terai Flood – Simplified Early Action Protocol (SEAP2024NP01)*. https://reliefweb.int/report/nepal/nepal-western-terai-flood-simplified-early-action-protocol-seap2024np01

[6] Paschim Press. (2024, August 11). *Flood in Bhajani and Tikapur: Searching for a long-term solution*. https://english.paschimpress.com/posts/192

[7] My Republica. (2022, October 12). *700 families displaced due to floods in Tikapur*. https://myrepublica.nagariknetwork.com/news/700-families-displaced-due-to-floods-in-tikapur

[8] Nepal Live Today. (2024, July 8). *Floods, waterlog settlements in Kailali*. https://www.nepallivetoday.com/2024/07/08/floods-waterlog-settlements-in-kailali/

[9] Rising Nepal Daily. (2024, October 13). *Early Warning System comes to the rescue of communities in Kailali*. https://risingnepaldaily.com/news/50353

stakeholders, gather their feedback, and understand how useful it can be for the municipality and other local actors in improving disaster preparedness and early warning efforts.

The event is expected to serve as a platform for reciprocal learning between technical experts, system developers, and disaster risk management stakeholders at the local level. It aims to ground the system in the daily lives of people affected by floods and guide ongoing improvements to make the DSS more user-friendly and effective.

The key purposes of this event include the following:

- Presenting the operational functionality of the Satark DSS and mobile app
- Introducing the stakeholders to the flood models operationalised in Satark for Tikapur: the WRF Flash Flood Threat and the Flood Warning Model Tikapur.
- Understanding how communities receive and act on early warnings, and what improvements are needed to make the system more effective.
- Exploring how scientific forecasts and traditional coping knowledge can be harmonised for stronger local preparedness.

The interaction will contribute toward a more inclusive and participatory model of disaster preparedness in which community voices actively shape the design and delivery of climate information services.

3. Specific Objectives

The specific aims of this experience-sharing event are:

- To orient municipal officials, local stakeholders, and disaster responders on the Satark DSS.
- To demonstrate the technical basis, data inputs, and practical use of the WRF Flash Flood Threat and Flood Warning Model Tikapur.
- To gather user experiences on early warning access, dissemination channels, and community responses.
- To identify implementation gaps and areas of improvement in local flood preparedness efforts.
- To build awareness on integrating scientific modelling with grassroots knowledge for improved flood risk governance.

4. Satark System: Tools and Relevance for Tikapur

Satark DSS synthesizes forecast products, hazard triggers, and exposure data into a user-friendly interface. Key features relevant to Tikapur include:

i. WRF Flash Flood Threat (FFFT)

The WRF Flash Flood Threat (FFFT) model, embedded in the Satark DSS, is derived from the South Asia Flash Flood Guidance System (SAFFGS) and utilizes rainfall forecast data provided by the Department of Hydrology and Meteorology (DHM) of Nepal. This model identifies regions at risk of flash flooding by analysing whether forecasted precipitation exceeds predefined Flash Flood

Guidance (FFG) thresholds over specific durations. Specifically, the model calculates the difference between Forecast Mean Areal Precipitation (FMAP) and the corresponding FFG values at 3-hour and 6-hour intervals. The outputs, expressed in millimetres, indicate how much rainfall will likely exceed the riverbank-full thresholds, thus flagging possible flash flood scenarios.

The FFFT provides critical sub-basin level outputs:

- FFFT1 03-hr: Difference of 3-hour FMAP from 3-hour FFG.
- FFFT1 06-hr: Difference of 6-hour FMAP from 6-hour FFG.

These results are generated for selected sub-basins and are visualised through both tabular and spatial map formats within the DSS interface. The tool enables municipalities like Tikapur to anticipate and prepare for localized flash flood events with improved lead time and geographic precision.

ii. Flood Warning Model Tikapur

The Flood Warning Model developed for Tikapur Municipality uses the Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) and integrates several technical components suited for complex river systems. The model specifically covers the Mohana and Karnali basins, and portions of the Pathariya basin, which includes the Pathariya River (Jamara in the north and Kulariya in the west), Mohana River in the south, and Karnali River in the east.

Key components of the model include:

- Soil Moisture Accounting (SMA) for infiltration and loss estimation
- Mod-Clark method for precipitation-runoff transformation
- Linear Reservoir model for base flow simulation
- Lag method for routing surface runoff

The model is driven by rainfall forecasts from the European Centre for Medium-Range Weather Forecasts (ECMWF) provided at 6-hour intervals. Calibration and validation of the model were performed using observed data from 2022 and 2023 at the Pahalmanpur station along the Kandra River. The model outputs hourly discharge forecasts for the downstream locations, including return period classifications:

- 2-year return period: Indicative of frequent, low-impact flooding
- 10-year return period: Reflects moderate to severe flood scenarios

The system flags alerts when forecasted discharge surpasses these thresholds, supporting anticipatory action for communities in the identified floodplain. These model outputs are hosted on a centralised server and integrated into the Satark DSS to generate site-specific flood risk information for Tikapur and surrounding settlements.

iii. Filter Options and Exposure Data

An essential functionality of the Satark DSS lies in its customizable filter options that enable users to narrow down risk information to their specific administrative or geographical areas. This feature is particularly useful for municipal and ward-level disaster responders who require quick and relevant

visual data for operational planning. The filter mechanism not only simplifies access to flood forecast outputs but also allows users to overlay multiple layers of hazard exposure and vulnerable infrastructure.

By applying location-specific filters, stakeholders can focus on municipality and view flood incidents, assess population clusters at risk, and pinpoint critical resources such as evacuation shelters, warehouses, and medical posts. This enables field teams to coordinate anticipatory actions and develop contingency strategies grounded in forecast data and spatial exposure maps.

Through the Satark interface, users can:

- Select specific locations down to the municipal and ward level.
- Visualise flood model outputs, rainfall forecasts, and hazard overlays.
- Access exposure data, including infrastructure (e.g., evacuation centres, warehouses), population clusters, household clusters, past flood incidence, and available resources.
- Plan and visualise evacuation routes and emergency logistics.

5. Event Agenda and Content Overview

The event is structured as a four-to-five-hour session with the following key segments:

A. Inaugural Session

- Welcome by Tikapur Municipality
- Introduction to the CARE Project by RIMES
- Brief background on flood trends and EWS in Tikapur
- Objectives of the experience-sharing event

B. Satark DSS Demonstration

- Live walkthrough of the system by the system developer team
- Selection of the Tikapur municipality from the interface
- Step-by-step navigation of model outputs: flood forecasts, infrastructure overlays, alert levels
- Use of filters to access localised hazard and exposure data

C. Technical Presentation by RIMES Expert

- Architecture and methodology of WRF Flash Flood Threat and HEC-HMS model
- Data sources, calibration methods, limitations, and validation
- Understanding how flood forecasts are generated and interpreted
- Use cases of system deployment in other municipalities

D. Stakeholder Discussion and Experience Capture

This segment is designed to gather the lived experiences of stakeholders, community members, and local institutions regarding early warning communication and disaster response in Tikapur. Given the recurring nature of floods in the region, community actors have developed various coping mechanisms and communication routines which can offer valuable insights into the actual effectiveness of forecast dissemination, the timing of alerts, and community-level decision-making.

The facilitated discussions will explore how people receive early warnings, whether the information is clear and trusted, and how different population groups respond when a warning is issued. The session also aims to uncover existing bottlenecks in the early warning chain, such as language barriers, timing of alerts, and the availability of supporting infrastructure for evacuation and preparedness. By doing so, this discussion becomes critical not only for validating the technical tools but also for shaping inclusive disaster governance that prioritises end-user needs.

Facilitated group discussions will cover:

- Local experiences with early warning—timing, reliability, dissemination pathways
- Channels used for alerting (e.g., radio, SMS, loudspeakers, ward announcements)
- Community response patterns, evacuation readiness, and constraints
- Issues of message comprehension and actionability
- Identification of barriers to access of early warning information

E. Reflection and Recommendation Building

The final session of the event will focus on synthesising insights and translating discussions into actionable recommendations. This segment invites all participants—from municipal officials to frontline community actors—to reflect on what they have learned from the demonstration and dialogue sessions and how that knowledge can be converted into system enhancements, policy changes, or behaviour shifts.

The objective here is to ensure that the event goes beyond awareness-raising and contributes directly to improving early warning systems at both the technical and operational levels. Participants will be encouraged to identify immediate areas for intervention, medium-term improvements in coordination and preparedness, and long-term strategies for sustained community engagement. These reflections will form the backbone of a post-event summary report and will inform future training modules, DSS updates, and municipal planning cycles.

6. Facilitation and Participation Strategy

Facilitators will include the RIMES team including , the system development team, municipality representatives, and the ToT recipient. The session will use interactive methods like live demos and moderated discussions. Expected 25-30 participants to accommodate fruitful discussion and interaction. Participation will include:

- Local DRRM stakeholders
- Ward disaster focal persons
- DAO and DEOC representatives

- Security forces, school teachers, and development partners
- Women's groups and community volunteers
- Community Disaster Management Committee (CDMC) members

7. Venue and Logistical Arrangements

- Venue: Venue with AV facilities
- Time: Morning (9:00 AM – 1:00 PM)
- Equipment: Projector, laptop, portable speakers, charts, printed IEC materials
- Refreshments: Tea/snacks for participants
- Documentation: Photo records, audio records, participation sheet

8. Expected Outputs

The experience-sharing event is designed to generate a combination of technical learning, user-centred feedback, and institutional engagement to advance the application of localised flood early warning systems. Through guided demonstrations, presentations, and participatory reflection, it will offer a platform for enhancing stakeholder understanding of the Satark system while exploring its potential to influence real-time decision-making in the context of flood hazard.

The expected results include the following:

- Improved familiarity with the Satark DSS interface and mobile app, especially its hazard forecasting and exposure visualisation functions, tailored to Tikapur.
- Strengthened understanding of the two flood models—WRF Flash Flood Threat and Flood Warning Model Tikapur and their operational integration in the system.
- Documented insights from participants regarding their current use of early warning information, perceived gaps, dissemination barriers, and trust in risk communication.
- Enriched partnerships among municipal bodies, disaster management agencies, and community representatives for improved coordination in flood response.
- Practical suggestions gathered for refining system usability, accessibility, and inclusiveness particularly to vulnerable populations.

These outcomes will support the continuous improvement of the Satark system. They will also inform wider strategies for institutionalising community feedback in flood risk communication, enhancing disaster preparedness, and promoting evidence-based local governance.

9. Conclusion

This community-based experience-sharing event in the Tikapur Municipality is a locally grounded effort to reflect on and strengthen early warning systems for flood risk management. Rooted in the realities of a flood-vulnerable region, the event serves not merely as a technical orientation but as a practical step toward embedding decision-support systems into everyday municipal and community

practices. It recognises that the success of a system like Satark depends not only on its scientific rigour but also on its usability and acceptance by those who must rely on it during emergencies.

The event enabled stakeholders to critically examine the strengths and gaps in existing flood information services through focused demonstrations, facilitated discussions, and participatory feedback sessions. Participants identified operational challenges, inconsistencies in communication flow, and barriers that hinder timely community responses. At the same time, they offered context-specific insights that could directly inform the refinement of DSS outputs, improve last-mile connectivity, and enhance coordination among institutions.

The reflections and recommendations from this engagement are expected to contribute to broader institutional learning and system development under the CARE project. More importantly, they reinforce the idea that disaster preparedness and resilience are processes co-owned by institutions and communities alike, where local experience, traditional knowledge, and scientific tools must converge to create actionable solutions for those most at risk.

10. Event Schedule

Time	Session	Description
9:00 – 9:20	Registration and Opening Remarks	Welcome by Tikapur Municipality and an overview of event objectives
9:20 – 9:40	Introduction to CARE Project and Satark DSS	RIMES presents the project background and DSS development rationale, and objectives of the event
9:40 – 10:15	Demonstration of Satark DSS and mobile app	Live walkthrough with localized filters for Tikapur and flood exposure visualisations.
10:15 – 10:45	Technical Presentation on Flood Models	Explanation of WRF Flash Flood Threat and Tikapur Flood Warning Model by the RIMES team
10:45 – 11:30	Stakeholder Discussion and Experience Capture	Group reflection on early warning experiences, challenges, and communication practices
11:30 – 12:15	Reflection and Recommendation Building	Structured sharing of suggestions for strengthening EWS and EW dissemination and coordination
12:15 – 1:00	Closing Session	Summary of key insights, feedback collection, and concluding remarks by local authorities and facilitators
1:00	Refreshments	